Epitomes

Important Advances in Clinical Medicine

Ophthalmology

The Scientific Board of the California Medical Association presents the following inventory of items of progress in ophthalmology. Each item, in the judgment of a panel of knowledgeable physicians, has recently become reasonably firmly established, both as to scientific fact and important clinical significance. The items are presented in simple epitome and an authoritative reference, both to the item itself and to the subject as a whole, is generally given for those who may be unfamiliar with a particular item. The purpose is to assist busy practitioners, students, research workers, or scholars to stay abreast of these items of progress in ophthalmology that have recently achieved a substantial degree of authoritative acceptance, whether in their own field of special interest or another.

The items of progress listed below were selected by the Advisory Panel to the Section on Ophthalmology of the California Medical Association, and the summaries were prepared under its direction.

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Recent Developments in Radial Keratotomy

RADIAL KERATOTOMY is a surgical procedure designed to correct nearsightedness (myopia). During the procedure, the surgeon uses a diamond-bladed micrometer knife to make spoke-like partial-thickness radial cuts in the paracentral and peripheral cornea to produce corneal flattening, which reduces myopia. In the early 1980s the operation was growing in popularity but had not been formally tested. In 1981 the National Eye Institute funded the Prospective Evaluation of Radial Keratotomy (PERK) Study to investigate the safety and efficacy, predictability, and stability of radial keratotomy. The PERK results and those of other studies have shown that almost all patients become less myopic with few serious complications. Those with less myopia had better results four years after the procedure. Approximately 75% of patients in the PERK study had 20/40 vision—unrestricted driver's license vision—or better without glasses, and 64% wore no optical correction. The predictability of results for an individual patient has been less than desired, however. New technology and surgical techniques are improving the predictability, and, as a result, about 80% of operated eyes now fall within the ± 1.00 diopter range, the ideal result being mild residual myopia (– 0.50 diopters).

Based on results reported to date, the relative safety of radial keratotomy is documented. Severe vision-threatening complications have been rare, and the most common complications, although not insignificant, have been a loss of two or three Snellen lines of best corrected visual acuity. This occurred in 2.5% of the patients in the PERK study at four-year follow-up.

Surgeons doing radial keratotomy previously used 16 or more incisions; the PERK study used 8, and many surgeons are currently using 4 initial incisions. If an undercorrection occurs, the original incisions can then be lengthened or deepened, or additional incisions can be added. Further studies will be required to examine the effectiveness of these techniques in improving predictability.

All of the major radial keratotomy studies have reported the phenomenon of a continued progressive effect of the surgical procedure in some patients. From 15% to 31% of patients' operated eyes have had a continuing decrease of – 1.00 diopter or more—a change toward farsightedness—from one to four years after the operation. There is speculation that this is associated with wound healing, and some data support an association between an incisional depth of greater than 90% of corneal thickness and instability. Follow-up results beyond five years will provide useful information regarding this problem.

In the longer term, two technologic applications may improve radial keratotomy results and its predictability. By the use of finite-element computer simulation of the cornea, the theoretic results of radial keratotomy can be studied. The correlation of theoretic and experimental results will lead to a better understanding of the biomechanics of the cornea and to better surgical techniques. In addition, computerized imaging of the corneal shape, videokeratography, allows more detailed study of the optical properties of the cornea after the surgical procedure.

The second new technology is using excimer lasers to do corneal operations. Two strategies that use pulsed 193-nm argon fluoride ultraviolet lasers to remove submicron amounts of tissue are being investigated. Laser keratomileusis involves reshaping the anterior surface of the cornea. The laser can also be used to make linear excisions, as in standard radial keratotomy, but wound healing remains a problem.

Altogether, about 15 different corneal surgical techniques to correct refractive errors are being investigated, and the field remains one of the most active and intriguing in ophthalmology.

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Current Uses of Collagen Shields

COLLAGEN SHIELDS are biodegradable contact lens-shaped films made of porcine or bovine scleral collagen. After placement on the eye, naturally occurring enzymes in the tear film cause the shields to dissolve over a 24- to 72-hour period, depending in part on the degree of collagen cross-linking induced at the time of manufacture. Their use as a clinical tool in ophthalmology is now widely accepted.

Recent studies have proved the collagen shield to be an excellent vehicle for drug delivery to the eye. Dexamethasone, gentamicin, tobramycin, and vancomycin hydrochloride all have been shown to have equal or greater concentrations in the cornea, aqueous, and iris when a soaked collagen shield was placed on the eye as when hourly drops or subconjunctival injections were used. The shields also have been shown to enhance corneal epithelialization postoperatively and after corneal abrasions.

In light of this recent research, some ophthalmologists are now routinely using collagen shields soaked in antibiotics and corticosteroids postoperatively as a replacement for subconjunctival injections in cataract, corneal, and anterior segment procedures. Follow-up has shown these eyes to be less inflamed in the immediate postoperative period with less discomfort. Other potential applications are using the shield in treating bacterial corneal ulcers, enhancing the healing of persistent epithelial defects or neurotrophic corneal ulcers, and possibly as an adjunct to dry eye therapy.

The collagen shields' capability of drug delivery, protection, lubrication, and accelerating epithelialization makes them particularly useful in ophthalmic surgical procedures and should prove to be a valuable therapeutic tool.

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Botulinum Toxin for the Treatment of Blepharospasm and Strabisumus

IN HIS PIONEERING WORK, Scott showed that an injection of small quantities of a purified reconstituted solution of botulinus toxin type A (Oculinum) into an extraocular muscle will cause a dose-related but temporary paralysis of the muscle. The drug is intended as a medical alternative to the surgical procedures currently used to treat blepharospasm and certain strabismus conditions. A chemically denervated muscle will cause a change in the position of the eye. With prolonged administration, some degree of contracture of the antagonist muscle is thought to occur, presumably resulting in a lasting alteration of ocular alignment.

The Food and Drug Administration (FDA) has recently granted premarket approval to botulinus toxin for treating blepharospasm and strabismus in patients at least 12 years old. Oculinum, which is a lyophilized form of purified botulinus toxin type A, blocks neuromuscular conduction. When injected in therapeutic doses, it produces a local denervation muscle paralysis that is useful in reducing the severe muscle contractions associated with blepharospasm. Botulinus toxin type A is administered by a subcutaneous injection at specific sites around the eye. Its beneficial effects last an average of 12½ weeks. Injections may need to be repeated, and this should not be viewed as a failure.

In one clinical study, botulinus toxin type A was administered to 27 patients with essential blepharospasm, 26 of whom had been treated unsuccessfully with benztropine mesylate, clonazepam, baclofen, or some combination of the three. Of the 27 patients, 25 reported improvement within 48 hours of the initial treatment. One patient's blepharospasm was later controlled with a higher dose. The other patient reported only mild improvement. In an open trial to test the effectiveness of the antitoxin in treating strabismus, 667 patients with strabismus were given one or more injections of the drug. Of the 667 patients, 55% had improved to an alignment of ten prism diopters or less when evaluated six months or more after injection. To date, 4,000 patients have received more than 7,000 injections to treat strabismus. Likewise, in the treatment of blepharospasm, more than 4,000 patients have received well over 7,000 treatments.

Although some practice with the technique is important, once the skill is acquired, it is a relatively safe office procedure for treating strabismus that requires only an injection of the drug into the extraocular muscle. Although successive treatments may be necessary, the success rate approaches that of standard strabismus surgical procedures.

At this time, the FDA has released botulinus toxin type A for the treatment of strabismus in patients 12 years of age and older, excluding it for the treatment of childhood strabismus and particularly for infantile esotropia. Currently, however, there are research protocols in effect for the treatment of congenital esotropia, and early reports indicate promising results.

Transient ptosis has been reported as a side effect in about a third of the patients, and some investigators have reported unexpected hypertropias at a rate of 15%. Other complications that have been reported are 9 cases of scleral perforation, none of which resulted in retinal detachments, and 15 cases of retrobulbar hemorrhage, again with no permanent disability resulting.

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Evaluating Functional Vision

VISION TRADITIONALLY HAS BEEN evaluated using a Snellen chart and notation. The chart presents black and white letters of different sizes that are scaled to quantify the resolution of the eye. Patients frequently complain that their vision deteriorates as they age and that they have trouble seeing to drive at night. The Snellen eye chart often reveals normal acuity in these persons. The standard eye chart was developed during the Civil War period before the invention of the electric light bulb or high-speed driving. Disorders such as cataracts, diabetes mellitus, and macular degeneration may not be evaluated properly with the existing eye chart. The term functional vision has been coined to describe what we need to test. This denotes the visual ability to perform under various lighting situations.

The Snellen system tests the resolution of our eyes with black letters on a white background. Most of our vision is achieved by detecting the differences between borders, however. The degree that a person can determine the sub-